Science of Summer
Family Activities

Kitchen Chemistry: Make ice-cream in a bag

Overview

This do-it-yourself treat also serves as a simple chemistry lesson. Investigate changing states of matter, chemical reactions, and the properties of ice and salt while working for your dessert.

Materials

- 1 cup half & half or milk
- ½ teaspoon vanilla
- 2 tablespoons sugar
- 4 cups crushed ice
- ½ cup rock salt
- 2 quart size zip-top plastic bags
- 1 gallon size zip-top freezer bag
- crushed cookies, candies, nuts or berries (optional for add-ins)

Thought Starters

Ask these questions before you begin:

- *What is the freezing point of water?*
    - *A: 32 degrees Fahrenheit or 0 degrees Celsius*
- *What is the freezing point of salt water?*
    - *A: It depends on how salty it is.*
- *Is the freezing point of salt water warmer or colder than plain water?*
    - *A: Colder*
- *What happens when you put salt on ice, like on an icy road in winter?*
    - *A: The salt melts the ice.*
- *So why do we mix salt with ice to freeze ice-cream?*
    - *A: Let's make it and find out!*

Activity

- Pour the first three ingredients into a quart-size zip-top bag. Squeeze out air and seal the bag tightly. Place inside the second quart-size bag, and seal.
- Place the double-bagged ingredients inside the gallon-size freezer bag. Fill the freezer bag with ice, pour in the rock salt, squeeze out air, and seal.
    - *The salt will begin to melt the ice because salt lowers the freezing point of water.*
- Now comes the fun part: Gently shake the bag, making sure the ice is evenly spread out. Continue to gently shake and knead the bag in your hands.
    - *The energy from shaking and kneading—and the heat transferred from your hands—causes the ice to melt further. Melting ice doesn't look as cold as frozen ice, right? But remember, it's mixed with salt. As the*

    melting ice combines with the salt, the salt-water solution has a lower freezing point than plain water. So the melted ice is actually colder than the original ice!

- Can you guess how long it will take for the liquid to freeze into a solid? (It should take between 5—10 minutes.)
    - *During the ice-cream making process, the ice (a solid) turns into a liquid (melted ice). When ice absorbs energy, it changes the phase of water from a solid to a liquid. The ice absorbs energy from the ice-cream ingredients and also from your hands as you hold the bag. The molecules start moving around again as the ice melts.*
- Use a thermometer to find the temperature of the melted ice. Was your guess on the mark?
- Eat your ice-cream straight out of the bag, then wash and recycle the bag to use again!

Discussion points

- Salt makes ice melt. That's why people sprinkle it on icy roads and driveways in cold climates. How does salt do this? It actually lowers the freezing point of the ice. Water normally freezes at 32 degrees Fahrenheit, or 0 degrees Celsius.

- Salt water is harder to freeze than plain water. You have to make it colder than 32 degrees Fahrenheit in order to freeze it. That's one of the reasons why a fresh water pond will freeze before one that's mixed with salt water from a nearby ocean. If you put two ice cube trays in the freezer, one with plain water and the other with a salt water solution, the plain water will freeze first.

- Do some experiments and test solutions with different concentrations of salt to see how freezing points compare. Practice your math skills to figure out proportional measurements (in cups and ounces) of salt and water. For instance:
    - water w/ 10% salt freezes at 20 degrees Fahrenheit
    - water w/ 20% salt freezes at 2 degrees Fahrenheit

- Not all types of salt work the same. The larger the salt crystals, the more time it takes to dissolve. This keeps it colder, longer. You could experiment with table salt, kosher salt and rock salt to test this.

- As salt melts, the compound (NaCl) breaks into two parts—Na and Cl. These particles then disrupt the arrangement of the ice crystals.

- This process changes the state of matter. For example, the liquid (milk mixture) turns into a solid (ice-cream). As the liquid gets colder it expands. (Have you ever put a soda bottle in the freezer and forgotten about it? The liquid expands and then explodes!) The molecules in the liquid slow down and eventually freeze in place.